

Effect of population-based training programs on bystander willingness to perform cardiopulmonary resuscitation

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ABSTRACT

Objective. This study was performed to determine the factors related to unwillingness of bystanders to perform cardiopulmonary resuscitation (CPR), and improvement of willingness among the lay public after CPR training.

Design. Retrospective design

Methods. We collected questionnaires received from laypersons attending CPR training courses implemented by the CPR Improvement Program of Chang Gung Memorial Foundation. Pre- and post-training questionnaires were given to participants attending CPR training courses between September 2013 and January 2014.

Results. Among the 401 respondents at pre-training, higher educational level (odds ratio, 3.605; 95% confidence interval [CI], 3.055 – 8.284) and previous CPR training (odds ratio, 1.754; 95% CI, 1.049 – 2.932) were significantly associated with willingness to perform bystander CPR. Significant improvements in willingness to perform conventional CPR and hands-only CPR on a stranger were observed after training ($P = 0.016$ and $P < 0.0001$, respectively). Approximately half of the respondents claimed that fear of doing further harm was the primary reason for their lack of willingness to admin-

ister conventional CPR on a stranger.

Conclusions. We showed that CPR training significantly increased the rate of willingness to perform CPR on strangers as well as acquaintances among the lay public. This study also showed that fear of doing further harm was the most significant barrier after training. This concern should be addressed in future training programs.

Key words: cardiopulmonary resuscitation, cardiopulmonary resuscitation training, bystander willingness

INTRODUCTION

Out-of-hospital cardiac arrest (OHCA) has become a global public health problem. The incidence of OHCA varies between countries, (1) but the global incidence is between 50 and 60 per 100,000 person-years worldwide. (2) The survival rate for OHCA is generally low, ranging from 5% to 10%. (3,4) A nationwide population-based study using the Taiwan National Health Insurance Research Database (NHIRD) showed that the overall incidence rate of OHCA was 51.1 per 100,000 persons during the period from 2000 to 2012. (5) Wang also reported that the overall 1-day, 30-day, and 180-day mortality rates of all OHCA patients were 81.3%, 89.1%, and 90.2%, respectively. These findings indicate the importance of early resuscitation. It is generally acknowledged that

immediate cardiopulmonary resuscitation (CPR) can increase the chance of survival after OHCA. (6-9)

However, studies have shown that not all people are willing to perform CPR on strangers when they witness OHCA. (10,11) Therefore, CPR training courses for the lay public have been increasingly emphasized as a means of improving these low bystander CPR rates. The reasons why people are unlikely to administer CPR have also been examined, and include fear of doing CPR incorrectly, being physically unable to perform CPR, fear of harming the individual, fear of transmittable diseases, belief that the person was dead, and legal liability. Many studies have indicated that mouth-to-mouth ventilation is an important factor in the public's unwillingness to perform bystander CPR, particularly on a stranger. (12-15) Although not mentioned in many studies, fear of legal consequences has also been reported to be a factor rendering respondents less likely to perform bystander CPR on strangers.

In Taiwan, mouth-to-mouth ventilation and legal concerns seem to be significant barriers to performing bystander CPR. However, there have been few studies regarding Taiwanese attitudes toward CPR. It remains unclear why laypersons are unlikely to engage in CPR even after taking many CPR courses. Therefore, this study was performed to investigate the factors

affecting layperson willingness to perform CPR on a stranger, family member, or friend as well as the reasons for not performing bystander CPR before and after attending CPR training.

METHODS

Study design

This study was performed to examine whether attending CPR courses would improve willingness to perform bystander CPR and related factors using a researcher-conducted questionnaire from the IGOGO program in Taiwan. The IGOGO program was supported by Chang Gung Memorial Hospital (CGMH) with the aim of introducing and improving CPR skills in laypersons. In this program, participants were asked to complete an anonymous questionnaire before and after a CPR training course to ascertain their willingness to perform CPR.

In the present study, we extracted data from these questionnaires regarding participant demographics, willingness to perform CPR, and reasons for not performing CPR. The factors associated with pre-course willingness to perform CPR, as well as the effects of the training program in the general population in Taiwan, were analyzed. The study was approved by the Institutional Review Board (IRB) of CGMH. The requirement for informed consent was waived by the IRB.

Study population and CPR course

The participants were recruited from among the general population, and were basically laypersons. Participants less than 20 years of age were excluded. A total of 20 standard 90-minute CPR training courses were held during the study period. Each course consisted of a 60-minute CPR teaching video with practice, 20 minutes of automated electrical defibrillator operation, and a 10-minute discussion with regard to the legal issues associated with bystander CPR in Taiwan. All of the CPR courses were undertaken in a small-group training setting with teacher-to-student and manikin-to student-ratios of less than 1:15 and 1:3, respectively.

Questionnaire

Pre-training and post-training questionnaires were given to participants who attended CPR training courses recruited

by IGOGO between September 2013 and January 2014. A period of 10 minutes was scheduled for the participants to complete the questionnaire. In the program, a 22-item questionnaire with closed questions was used to determine participant demographics, previous CPR training and experience, medical history, willingness to perform CPR, and reasons for lack of willingness to perform CPR. The questionnaire was based on previous studies conducted in other countries. The first section elicited responses regarding each participant's age, gender, education level, religion, occupation, past clinical experience, medical history, as well as previous CPR training. The second part of the questionnaire was related to willingness to perform traditional CPR or chest compression-only CPR on a stranger, family member, or acquaintance, and reasons for not performing CPR. All participants were instructed to complete the self-administered questionnaires in approximately 10 minutes before and after the CPR training courses.

Data analysis

The data collected were entered into an electronic database for analysis. Participants that returned completed questionnaires were defined as respondents. All returned questionnaires were included in the analysis. Statistical analysis was conducted using the SPSS for Windows software (SPSS Inc., Chicago, IL, USA). Descriptive analyses were performed on all variables. Continuous variables are presented as means and standard deviations, while categorical variables are summarized as frequencies and percentages. The paired t-test was used to compare continuous variables before and after CPR training. McNemar's test was used for comparison of categorical variables before and after CPR courses. Univariate and multivariate logistic regression models were used to identify potential factors influencing pre-course willingness to perform CPR. The results are presented as odds ratios (OR) and 95% confidence intervals (CI). In all analyses, $P < 0.05$ was taken to indicate statistical significance.

RESULTS

Demographics

A total of 638 pre-training questionnaires were collected, of which 401 were completed, giving a response rate of 62.9%. Post-training questionnaires were issued

to 355 (88.5%) participants, of whom 227 responded, giving a response rate of 63.9% (227/355). Of the 401 respondents, 153 (38.2%) were male and the mean (SD) age was 49.2 (10.3) years in all respondents (table 1). More than half of the subjects were married, held at least a high school diploma, had taken CPR training before, and specified Buddhism or folk beliefs as their religion. Approximately half of the respondents were employees of the military or government.

Factors affecting CPR willingness prior to attending CPR courses

Among the 401 respondents, 124 (30.9%) were willing to perform bystander CPR. Comparisons of demographics according to willingness to perform bystander CPR were performed. In total, 42 of the 124 respondents (33.9%) who were willing to perform bystander CPR, and 111 of the 277 respondents (40.1%) who were unwilling to perform CPR, were male. The results indicated statistically significant differences in age, education level, marital status, history of chronic illness, living with the elderly, and previous CPR training between the two groups (table 2). Therefore, multivariate analyses were used to evaluate the impact of these underlying factors on CPR willingness (table 3). On multivariate analysis, factors impacting bystander CPR willingness were education level and previous CPR training ($P < 0.05$). Odds ratios revealed that respondents with at least a high school diploma, who had taken CPR training previously, were most willing to perform bystander CPR.

Changes in CPR willingness before and after CPR courses

A total of 227 (63.9%) questionnaires were returned after CPR training courses. Among them, 90 (39.6%) respondents expressed willingness to perform bystander CPR. As shown in table 4, McNemar's test indicated significant changes in CPR willingness after training in participants who returned both pre- and post-training questionnaires. Prior to CPR training, 83 (36.6%) and 154 (67.8%) of the 227 respondents were willing to provide a stranger with conventional or hands-only CPR, respectively. More respondents were willing to perform either conventional or hands-only CPR for acquaintances before taking the CPR training course.

After the CPR course, significant increases

in the proportions of participants willing to perform conventional and hands-only CPR on a stranger or acquaintance were observed. An especially marked increase was observed in willingness to perform hands-only CPR on a stranger.

Main reasons for unwillingness to perform CPR before and after training

In the initial evaluation, unwillingness to give mouth-to-mouth ventilation, followed by fear of legal issues, accounted for 80% of the respondents that were not willing to resuscitate a stranger (67/144, 46.5% and 53/144, 36.8%, respectively), while fear of

causing further harm was the major reason for not performing bystander CPR after training (66 of the 137 respondents, 48.2%, that were unwilling to perform bystander CPR). After training, only 3 (2.19%) of the 137 respondents reported fear of legal issues. However, the proportion of respondents who were afraid of performing CPR incorrectly increased by almost double compared to before training (5.56% vs. 11.0%, respectively). In addition, a few people (8 of the 137 respondents, 5.84%) reported that they were unwilling to perform cardiac compression after attending CPR training.

On the other hand, 23 (76.7%) and 14 (56.0%) of the respondents reported fear of causing further harm as the main reason for their unwillingness to perform CPR on an acquaintance before and after training, respectively. Similar to unwillingness to perform bystander CPR, the proportion of respondents reporting fear of performing CPR incorrectly doubled after training, from 2 (20.0%) to 10 (40.0%) respondents, among those who were not willing to perform CPR on an acquaintance. The results are presented in table 5.

Table 1. Characteristics of respondents.

Demographics of 401 respondents	
Age in years (Mean±SD)	49.19±10.3
Gender (N,%)	
Male	153 (38.2%)
Educational level (N,%)	
≤High School	117 (29.2%)
>High School	284 (70.8%)
Marital status (N,%)	
Single or divorced	101 (25.2%)
Married	300 (74.8%)
Religion (N,%)	
None	118 (29.4%)
Buddhism or folk beliefs	276 (68.8%)
Christianity or Catholicism	7 (1.8%)
Occupation (N,%)	
Military and government	152 (37.9%)
Farmers/fishermen, labors or business	136 (33.9%)
Self-employed/merchants	40 (9.98%)
Services	72 (18.0%)
Students	1 (0.25%)
Previous CPR training (N,%)	213 (53.1%)

CPR, cardiopulmonary resuscitation; N, number; SD, standard deviation.

Table 2. Respondents demographics by pre-course willingness.

Characteristic	Willing to CPR (n=124)	Unwilling to CPR (n=277)	P-Value
Age (years)	45.6 (9.6)	50.8 (10.2)	<0.001*
Male gender	42 (33.9%)	111 (40.1)	0.267
Educational level			
≤High School	25 (20.2%)	155 (56.0%)	<0.001*
>High School	99 (79.8%)	122 (44.0%)	
Marital status			
Single or divorced	44 (35.5%)	57 (20.6%)	0.0015*

Married	80 (64.5%)	220 (79.4%)	
Medical/paramedical personnel	16 (12.9%)	24 (8.66%)	0.190
Previous chronic disease	17 (13.7%)	84 (30.3%)	<0.001*
Previous major disease	2 (1.61%)	8 (2.89%)	0.730
Living with elderly (>65y/o)	55 (43.4%)	85 (30.7%)	0.008*
Experience of performing CPR in real life	2 (1.61%)	5 (1.81%)	>0.999
Previous CPR training	87 (70.2%)	126 (45.5%)	<0.001*
Last CPR learning time			
None	37 (29.8%)	151 (54.5%)	
<1 year	12 (9.68%)	13 (4.69%)	
1~2 years	14 (11.3%)	14 (5.05%)	
2~5 years	27 (21.8%)	42 (15.2%)	
>5 years	28 (22.6%)	41 (14.8%)	
Unclear	6 (4.84%)	16 (5.78%)	
Type of CPR course			
Traditional	40 (46.0%)	66 (52.4%)	
Hand-Only CPR	47 (54.0%)	60 (47.6%)	
Memory of last CPR course			
Very clear	12 (13.8%)	8 (6.35%)	
Clear	17 (19.5%)	23 (18.3%)	
Normal	28 (32.2%)	46 (36.5%)	
Unclear	29 (33.3%)	49 (38.9%)	
Very Unclear	1 (1.15%)	0 (0.0%)	

CPR, cardiopulmonary resuscitation; n, number; y/o: years old

* Statistically significant

Table 3. Potential factors that affecting the pre-course willingness of CPR.

Factors	Multivariate analysis	
	Odds ratio	95% CI
Level of education	3.605*	2.019~6.438
Male sex	1.241	0.760~2.029
Marital status	0.643	0.373~1.106
History of Chronic illness	0.617	0.327~1.167
Living with elderly	1.098	0.670~1.800
Previous CPR training	1.754*	1.049~2.932

CPR, cardiopulmonary resuscitation.

* Statistically significant

Table 4. Willingness to perform CPR before and after training.

Willingness	Before training (N=227)	After training (N=227)	P-value
Willing to perform CPR on a stranger	83 (36.6%)	90 (39.7%)	0.016*
Willing to perform hands only CPR on a stranger	154 (67.8%)	191 (84.1%)	<0.0001*
Willing to perform CPR on a known person	197 (86.8%)	202 (89.0%)	0.063
Willing to perform hands only CPR on a known person	200 (88.1%)	212 (93.4%)	<0.0001*

CPR, cardiopulmonary resuscitation; N, number of respondents

* Statistically significant

Table 5. Reasons for not to perform standard CPR.

Reasons	Before training	After training
Most important reason of not performing CPR on a stranger	N=144	N=137
Afraid of doing further harm	16 (11.1%)	66 (48.2%)
Afraid of doing CPR incorrectly	8 (5.56%)	15 (11.0%)
Afraid of legal issues	53 (36.8%)	3 (2.19%)
Unwilling to give mouth-to-mouth breaths	67 (46.5%)	45 (32.9%)
Unwilling to perform cardiac compression	0 (0.0%)	8 (5.84%)
Most important reason of not performing CPR on a known person	N=30	N=25
Afraid of doing more harm	23 (76.7%)	14 (56.0%)
Afraid of doing CPR incorrectly	2 (20.0%)	10 (40.0%)
Afraid of legal issues	0 (0.0%)	0 (0.0%)
Unwilling to give mouth-to-mouth breaths	1 (3.33%)	0 (0.0%)
Unwilling to perform cardiac compression	0 (0.0%)	1 (4.0%)

CPR, cardiopulmonary resuscitation; N, number of respondents.

DISCUSSION

Willingness to perform bystander CPR, as well as potential factors affecting the willingness to perform CPR, were analyzed using a questionnaire survey. It is generally accepted that CPR training improves resuscitation attempts when a bystander witnesses a cardiac arrest. In a study on college students, 77% reported that they were likely to perform CPR or use an external defibrillator in an emergency situation after attending CPR courses. (16) Previous studies conducted in Asians and Caucasians also supported the suggestion that experience of CPR training is closely related to provision of CPR in an emergency. (17-20) Our findings were consistent with these previous studies. The results indicated that about 40% of the Taiwanese respondents were willing to perform CPR on a stranger, while 89% were willing to perform CPR on an acquaintance after training. In addition, an increase in willingness to perform hands-only CPR was also noted after training in the present study.

The respondents in the present study reported a much higher likelihood of providing chest compression-only CPR on a stranger than conventional CPR with mouth-to-mouth ventilation either before (67.8% vs. 36.6%, respectively) or after training (84.1% vs. 39.7%, respectively). Similar findings were also reported in previous studies. In a Korean study, more than 70% of the respondents were willing to provide hands-only CPR on a stranger

after basic life support training, while only 55.7% of the respondents were likely to perform conventional CPR on a stranger. (19) Large surveys in Japanese subjects also indicated that 50% – 100% of participants were likely to perform chest compression-only CPR, but only 10% – 30% would perform both chest compression and mouth-to-mouth ventilation on a stranger. (21) Chew et al. also found a low rate of definite “yes” responses regarding willingness to perform chest compression plus mouth-to-mouth ventilation on a stranger in comparison with chest compression only and chest compression with mask-to-mouth ventilation in a Malaysian population. (22) These observations indicated that chest compression may be a more suitable method for bystander CPR than mouth-to-mouth ventilation.

Moreover, it is not surprising that the rates of willingness to perform hands-only CPR and conventional CPR on a family member or an acquaintance were both much higher than those on a stranger in our study. Even with the high proportion of willingness to perform CPR on an acquaintance prior to training, improvements were also noted in willingness to perform both CPR techniques, especially hands-only CPR. The results were similar to those of several other studies. (19,22-24) Our results were also consistent with previous surveys in Australia, Japan, and the USA, in that respondents were less reluctant to perform CPR on an acquaintance than a stranger. (14,25,26)

The factors associated with reluctance to perform CPR have been elucidated in many studies. Our study suggested that education level and previous CPR training played roles in willingness to perform CPR. Swor reported that witnessed arrest, trained bystander, bystander with more than high-school education, and arrest occurring in a public location were important predictors of CPR performance. (18) Jackson and Swor found that patients in public locations were more likely to receive bystander CPR. (27) A study conducted in Queensland, Australia, also supported this suggestion. Social demographics affected willingness to perform CPR. Logistic regression analysis indicated that respondents who were male, married or in a de facto relationship, and had received CPR training within 1 year were more likely to perform bystander CPR. (15) In contrast, a study performed in Chicago, USA, did not show any association between CPR performance and socioeconomic status. (28)

Various reasons for unwillingness to perform bystander CPR were addressed in the present study, as well as in previous studies. Before training, the most important barrier to CPR performance was unwillingness to perform mouth-to-mouth ventilation; however, fear of doing further harm was ranked as the major barrier after training. Unlike a previous study in Korea, (19) in which fear of legal liability was the most significant barrier (cited by approximately 50% of respondents as a major reason for unwillingness to perform CPR even after

training), our study showed a significant decrease in fear of legal issues after training. This difference may have been due to the inclusion of explanations regarding legal issues associated with CPR in our training program. However, we also found that more respondents claimed to be more afraid of doing further harm to victims post-training compared to pre-training. We supposed that the respondents in our study were more concerned regarding legal issues before training, but after clarification in the training program, respondents began to consider whether they may cause further harm to the victims. Prior to training, respondents indicated the most significant barrier to CPR performance based on their impressions, which were obtained from the media or previous CPR courses. After training, they ranked the most important barrier according to the knowledge that they had obtained from the training course. Therefore, fear of doing further harm was ranked as the greatest obstacle to performing conventional CPR. A survey in Singapore indicated that fear of doing harm was the second greatest barrier to administration of CPR. (29) The respondents who were reluctant to administer CPR reported that fear of disease transmission and mouth-to-mouth ventilation were the most significant barriers to performing conventional CPR. In the USA (30) and

Sweden (31) over 80% of laypersons reported fear of disease transmission to be a concern, compared to only 18% of Australian respondents and 7%–23% of Japanese high school students and teachers. (15,21) In our study, 32.5% of the respondents who were not willing to perform conventional CPR indicated that unwillingness to perform mouth-to-mouth ventilation was the greatest barrier. The observed differences between nations may be due to differences in culture, the prevalence of infectious diseases, and the methodologies used in the studies. Our study required respondents to select the single most significant reason for not performing conventional CPR, while other studies provided multiple choices or open questions.

Due to the low willingness to perform mouth-to-mouth resuscitation on a stranger, new CPR training programs for laypersons should be adapted to emphasize the skills of compression-only CPR and the use of automated electrical defibrillators. Further studies will focus on the lay public's awareness of CPR and skills to improve bystander CPR willingness and bystander CPR rate.

Our study had some limitations. First, the questionnaire was not mandatory for course participants, and only 227 of 401

(56.6%) respondents returned both pre- and post-training questionnaires. Therefore, our study may not comprehensively reflect the trends in the general population. Second, we did not collect data regarding the underlying reasons for unwillingness to perform mouth-to-mouth ventilation, but we believe that fear of disease transmission may have partially accounted for this barrier. Finally, extending the questionnaire collection period may be helpful to obtain more data.

CONCLUSIONS

In summary, this study indicated that CPR training increased the rate of willingness to perform CPR on strangers and acquaintances among the lay public. This study also indicated that fear of doing further harm became the most significant barrier after training. This concern should be addressed in future training programs.

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